

HEART DISEASE AND STROKE

QUICK FACTS

Heart disease and stroke are two of the top four leading causes of death in the United States.^{1,2,3}

Air pollution is believed to be a significant environmental factor contributing to heart disease and stroke incidence.⁴

Of the 350,000 sudden cardiac deaths in the United States each year, an estimated 60,000, or 17%, are related to particulate matter air pollution.⁴

Cardiovascular diseases, including heart disease and stroke, have a major impact on U.S. public health. In fact, heart disease is the leading cause of death in the United States,¹ followed closely by stroke, the fourth leading cause of death.^{2,3} While the risks associated with heart disease and stroke are dependent on a number of factors, including genetics and behavior, there is a growing focus on the link between specific environmental factors and these disorders.⁵

INTRODUCTION

Heart disease is a term for a variety of different diseases affecting the heart. A stroke, also known as a cerebrovascular accident is a rapid loss of brain function due to disturbance in the blood supply to the brain.

This chapter focuses on three cardiovascular diseases with increasing evidence of environmental links—especially air pollution. These diseases include the following:

- Coronary Heart Disease
- Heart Attack
- Stroke

CORONARY HEART DISEASE (CHD)

The most common heart disease in the United States is *coronary heart disease* (CHD), also known as *coronary artery disease*. Coronary heart disease occurs when plaque (deposits of fat-like substances) builds up on the walls of the coronary arteries that supply blood to the heart muscle, hardening and narrowing those arteries. This process is called *atherosclerosis* and can lead to other heart disease conditions and outcomes, including acute *myocardial infarction* (AMI), typically known as a *heart attack*, and death.⁶

For many people, a heart attack is the first sign of heart disease. Others may first experience *angina*, chest pain or discomfort that occurs when the heart muscle is not getting enough blood. Angina is a major sign of existing coronary heart disease. Over time, coronary heart disease can weaken the heart muscle and lead to congestive heart failure, a serious condition in which the heart cannot pump blood efficiently. Some arrhythmias (irregular heartbeats) also increase the risk of developing blood clots and subsequent heart attacks or strokes.

ACUTE MYOCARDIAL INFARCTION (AMI) OR “HEART ATTACK”

A heart attack occurs when the blood supply to part of the heart muscle itself—the myocardium—is severely reduced or stopped. The reduction or stoppage happens when one or more of the coronary arteries supplying blood to the heart muscle are blocked, usually caused by atherosclerosis. The plaque can eventually burst, tear, or rupture, creating a “snag” where a blood clot forms and blocks the artery. This leads to a heart attack.

STROKE

A stroke occurs when the blood supply to part of the brain is blocked (ischemic stroke) or when a blood vessel in the brain bursts (hemorrhagic stroke), causing damage to a part of the brain.^{2,3,6} Death can result from an initial stroke event, and those who survive a stroke might be left with permanent disability. Stroke is a leading cause of serious long-term disability.



WHAT ARE THE RISK FACTORS FOR HEART DISEASE AND STROKE?

Certain health, hereditary, and behavioral factors play a major role in the risk for cardiovascular disease. In addition to hereditary and behavioral risks, environmental factors - especially air pollution - are of increasing concern.

The risk of developing heart disease is largely dependent on factors such as heredity and behavior (Table 1). The behavioral factors that seem to hold the greatest risk for these diseases are smoking, physical inactivity, and diet.

ENVIRONMENTAL RISK FACTORS

Pollutants inhaled through the lungs may be responsible for health effects in the cardiovascular and circulatory system.^{4,5,8,9} There is increasing evidence connecting short- and long-term exposure to ambient fine particulate matter (PM_{2.5}) with increased hospitalizations and deaths related to heart disease and, to a lesser degree, stroke.^{10,11,12,13,14,15,16} It is estimated, for example, that as many as 60,000 deaths from heart disease in the United States each year are related to particulate matter air pollution.⁴

And while the risk of heart disease and stroke from exposure to PM_{2.5} may be modest compared to other factors, the burden of these diseases attributable to PM_{2.5} is substantial, because everyone is exposed to this air pollutant every day throughout their lives.^{8,9,10,13} Additionally, there might be added risk for individuals who have one of the other risk factors, such as diabetes or obesity.³

Other environmental factors associated with increased risk of heart attack or stroke or both include second-hand smoke, extreme temperatures and persistent noise.

Table 1. Risk factors for heart disease and stroke⁷

Contributing Factor	Heart disease and heart attack	Stroke
High blood cholesterol	X	X
High blood pressure (hypertension)	X	X
Tobacco use	X	X
Dietary factors like saturated fats, cholesterol, and sodium (salt)	X	X
Physical inactivity	X	X
Obesity	X	
Diabetes	X	X
Family history of coronary heart disease or stroke	X	X
Heart disease		X
Fast and irregular heartbeat (atrial fibrillation)		X
Transient ischemic attack		X
Excessive alcohol consumption		X

Secondhand Smoke

Nonsmokers exposed to secondhand smoke have increased cardiovascular disease risk by 25%–30%. People who already have heart disease have a greater risk of a heart attack being triggered by exposure to secondhand smoke.¹⁷

Extreme Temperatures

In a number of studies of U.S. extreme-heat events, researchers have observed an excess of cardiovascular deaths and an increased risk of death among subjects with diagnosed heart disease during high or prolonged heat.^{18,19,20,21,22,23,24,25,26} Cold weather has been observed to be associated with coronary thrombosis (formation or presence of a clot), arterial hypertension (high blood pressure), hyperviscosity (a thickening of the blood caused by the accumulation of large proteins in the serum), and thrombosis (possibly leading to stroke).²⁷

Persistent Noise

Research has indicated that persistent noise may lead to stress which could increase the long-term risk of high blood pressure and coronary heart disease.^{28,29}

HOW ARE WE TRACKING HEART DISEASE AND STROKE?

Heart disease and stroke have been widely studied and can often be easily recognized and diagnosed. Consequently, there are numerous data sources that can be used for estimating prevalence, incidence, and risk factors for cardiovascular disease in the U.S. population.

Data on prevalence—how many people have cardiovascular disease at a given point in time—come through national health examination and interview surveys and some state-based surveys. These surveys collect data on self-reported medical conditions as well as a physical exam (blood pressure, weight, blood tests) that can be used to estimate risk factors for cardiovascular disease. Other sources of prevalence data include medical events, such as hospitalization, emergency room visits or a cardiovascular operation or procedure. The Environmental Public Health Tracking Program is tracking hospital admissions for heart attacks. The data are organized by different variables to measure the number of hospital admissions for heart attacks. The variables include time periods, age groups, and geographic areas such as states and counties.³⁰

Estimates of cardiovascular disease incidence, that is, the number of new cases of cardiovascular disease that will develop in the U.S. population, are extrapolations based on community or hospital-based studies. Finally, death certificate data are used to measure mortality from different kinds of cardiovascular diseases.

STATUS AND TRENDS OF HEART DISEASE AND STROKE

OVERALL HEART DISEASE

In 2010, heart disease was the number one leading cause of death, 597,689 people died of heart disease (including coronary heart disease and heart attacks) in the United States, about one-fourth of all deaths in that year.¹ Of all those heart disease deaths

- Eighty percent occurred in people aged 65 years and older.¹
- Death rates were lower among Hispanic and Latino, American Indian and Alaska Native, and Asian and Pacific Islander men and women than among white men and women.¹

In 2011, about 11% of the U.S. adult population (more than 25.5 million people) 18 years of age and older were living with heart disease of all types. Six percent had been told they had coronary heart disease, 24% had been told on two or more visits to their doctor that they had hypertension, and 2.6% had been told they had experienced a stroke.³¹

CORONARY HEART DISEASE

Of the 597,689 heart disease deaths in 2010, 379,559, or 64% were caused by coronary heart disease.¹ The prevalence of coronary heart disease has remained fairly stable since 1997. Although coronary heart disease remains the leading cause of U.S. deaths, death rates declined from 1999–2010 (see Figure 1).^{1,35}

- Coronary heart disease is the principal type of heart disease. Age-adjusted death rates for coronary heart disease show a gradual decline from 1999 to 2010, with a greater death rate for males than for females (Figure 1).^{1,35}
- Overall, age-adjusted death rate for coronary heart disease decreased for all races from 1999 to 2010 (Figure 2).³⁵



CORONARY HEART DISEASE DISPARITIES: RACE AND SOCIOECONOMICS

White men were more likely to report having coronary heart disease than African American or Hispanic men, but racial and ethnic differences were less noticeable among women.

A socioeconomic gradient exists: death rates and the prevalence of those living with coronary heart disease are higher in groups with less education and less income. It is possible that some of these disparities are related to differences in health care access, nutrition, and less awareness of preventive health care measures.³²

Socioeconomic gradients in disease rates might also be due to differences in exposure to environmental pollutants. Several researchers have suggested that exposure to some types of air pollution, including PM_{2.5}, may be higher in lower socioeconomic communities.^{32,33} It is possible that many lower income families live in closer proximity to major sources of PM_{2.5}, including busy freeways,³⁴ thereby placing these individuals at greater risk of heart disease and stroke. Evidence from health effects studies examining the role of socioeconomic status as a modifier of air pollution related cardiovascular disease risk is mixed. Most notably, a study conducted by the American Cancer Society reported higher mortality rates from long-term exposure to PM_{2.5} for people with less education.¹⁵ More research examining differences in exposure to environmental hazards by socioeconomic status is clearly necessary.

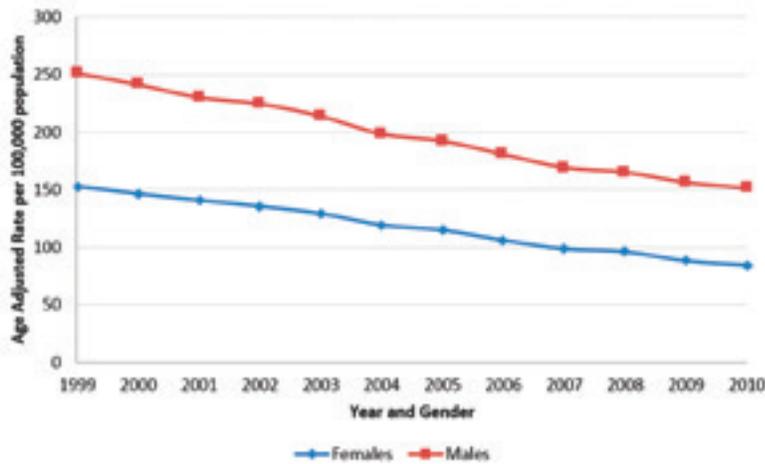


Figure 1. Age-adjusted death rates for coronary heart disease by gender, 1999-2010³⁵

Rates are per 100,000 persons and standardized to the 2000 U.S. population. Diseases are classified according to the 10th International Classification of Diseases (ICD-10) (codes 120-125).

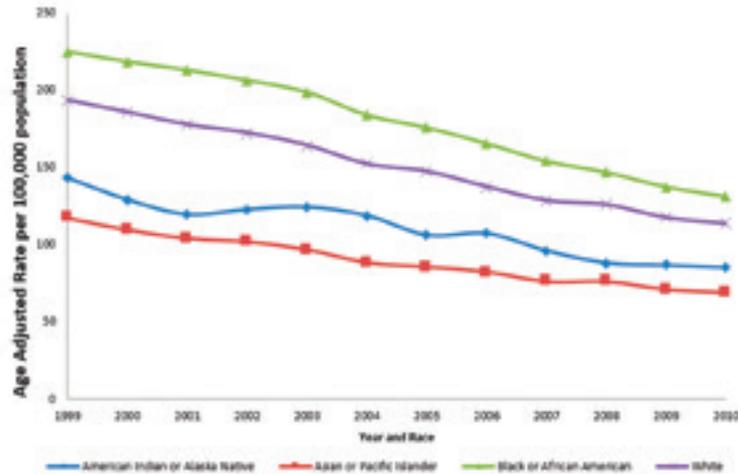


Figure 2. Age-adjusted death rates for coronary heart disease by race or ethnicity, 1999-2010³⁵

Rates are per 100,000 persons and standardized to the 2000 U.S. population. Diseases are classified according to the 10th International Classification of Diseases (ICD-10) (codes 120-125).

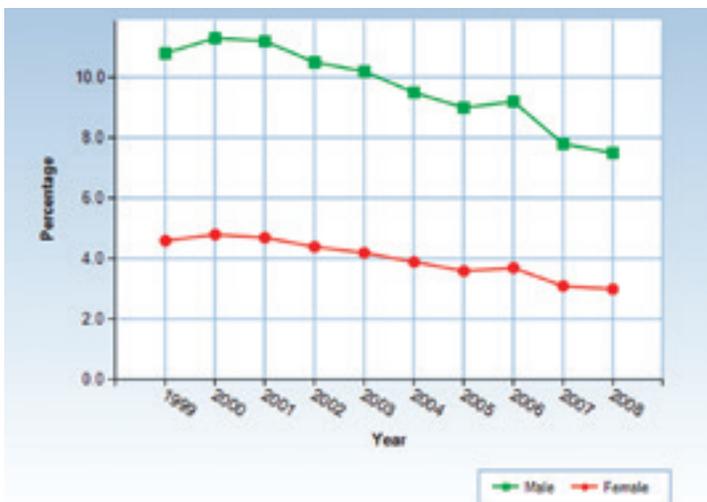
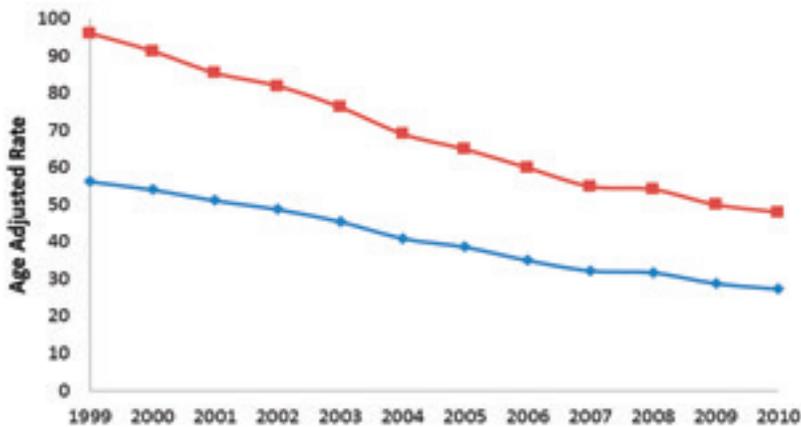
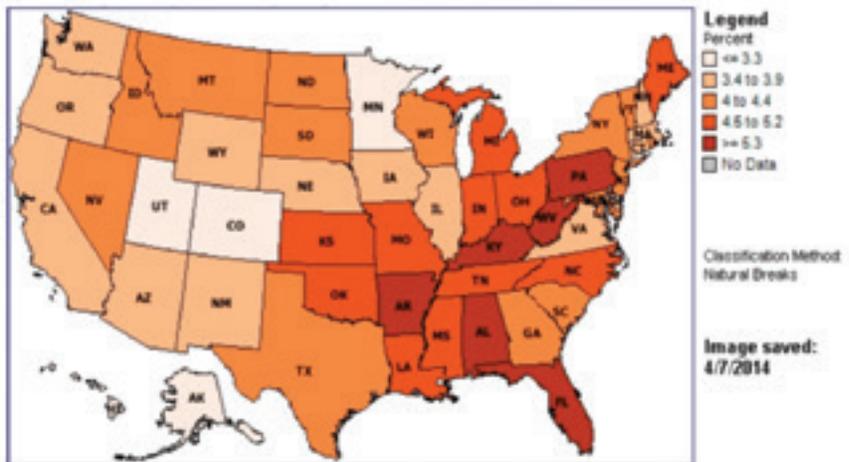


Figure 3. Hospitalization rates for coronary heart disease (ICD-9 codes 410-414, 429.2) by gender, 1999-2008³⁶

Rates are per 100,000 persons and standardized to the 2000 U.S. population. Diseases are classified according to the 10th International Classification of Diseases (ICD-10) (codes 120-125).

Figure 4. Self-reported prevalence of coronary heart disease among adults 18 years of age or older, 2011³⁷



Rates are per 100,000 persons and standardized to the 2000 U.S. population. Diseases are classified according to the 10th International Classification of Diseases (ICD-10) (codes 120–125).

Figure 5. Age-adjusted death rates for AMI or heart attack by gender, 1999–2010³⁵

- From 1999 to 2010, age-adjusted death rate for coronary heart disease was highest among African Americans and lowest among Asian or Pacific Islanders (Figure 2).³⁵

Hospitalization rates for coronary heart disease have also declined since 1999 (Figure 3). During 1999–2008, the percent of hospitalizations decreased from 10.8% in males and 4.6% in females to 7.5% in males and 3.0% in females, a reduction of 31% in males and 35% in females.³⁶ During that same time period, men were hospitalized for coronary heart disease more than twice as often as women.³⁶

- According to the 2011 Behavioral Risk Factor Surveillance System (BRFSS), self-reported prevalence of coronary heart disease is highest in West Virginia (6.7%) and lowest in Colorado (2.5%) (Figure 4).³⁷

AMI OR HEART ATTACK

In 2014, an estimated 620,000 Americans will have a new heart attack, and about 295,000 will have a recurrent attack.³ It is estimated that an additional 150,000 silent first heart attacks—heart attacks without recognized or easily recognizable symptoms—occur each year. About every 44 seconds, an American has a heart attack, and about every 1 minute and 23 seconds someone will die from one.³

The chief cause of heart attack is coronary heart disease. The death rate from heart attacks for males and females has declined in recent years (Figure 5).³⁵

In fact, of the 597,689 heart disease deaths in the United States in 2010, 20% were from heart attacks.¹ Of all those heart attack deaths

- About 76% occurred among people 65 years of age or older.¹

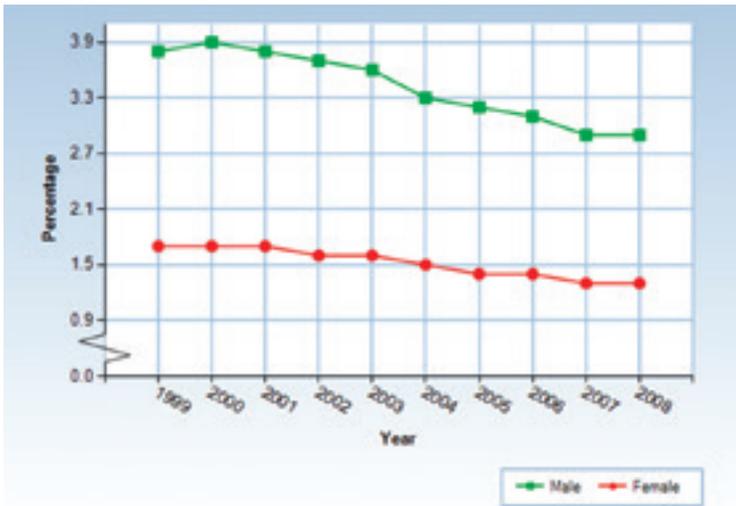


Figure 6. Hospitalizations for AMI or Heart Attack by gender, 1999-2008 (ICD-9 code 410)³⁶

Rates are per 100,000 persons and standardized to the 2000 U.S. population. Diseases are classified according to the 10th International Classification of Diseases (ICD-10) (codes I20–I25).

- The age-adjusted death rates for heart attacks from highest to lowest comparing the white and black races were African-American men, white men, African-American women and white women.¹
- Hispanic men had lower rates than did white men and Hispanic women had lower rates than did white women. However, white women had lower rates than Hispanic men.¹

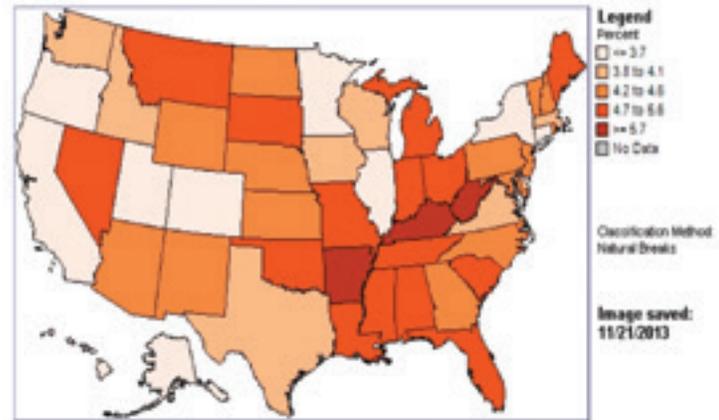


Figure 7. Self-reported prevalence of AMI (heart attacks) among adults 18 years of age and older, 2011³⁵

Figure 6 shows the hospitalizations for heart attack by gender for adults age 18 and older for 1999 to 2008.³⁶ Hospitalization rates for heart attack have declined since 1999 (Figure 6). During 1999–2008, the percent of hospitalizations decreased from 3.8% in males and 1.7% in females to 2.9% in males and 1.3% in females, a reduction of 24% in males and 24% in females.³⁶ During that same time period, men were hospitalized for heart attack more than twice as often as women.³⁶

- The highest prevalence of reported heart attacks was in West Virginia (6.6%) and lowest was in Colorado (2.4%) (Figure 7).³⁷

Figure 7 shows the percentage of BRFSS respondents answering yes to “Ever told you had a heart attack (myocardial infarction)?” during the 2011 survey.³⁷

STROKE

In 2011, 4.3% of the respondents to the Behavioral Risk Factor Surveillance System (BRFSS) who were 18 years of age and older reported ever having a history of AMI.³⁷ The data from BRFSS also showed

On average, every 4 minutes, someone dies from a stroke.³ In 2010, one in every 19 deaths in the United States were due to stroke.³ Between 1999 and 2009, the stroke death rate decreased 36.9%, and the number of stroke deaths per year decreased 22.9%.³⁸ Stroke death rates have declined in recent years for males and females and all the major races (Figures 8 and 9).³⁵ Geographic variation has been noted in stroke mortality: Areas in the southeast United States (where temperatures and humidity are high) have higher death rates from stroke than do areas elsewhere in the country.³⁹

- The prevalence of nonfatal heart attacks increases with age.
- Men have a greater prevalence of nonfatal heart attacks than women.

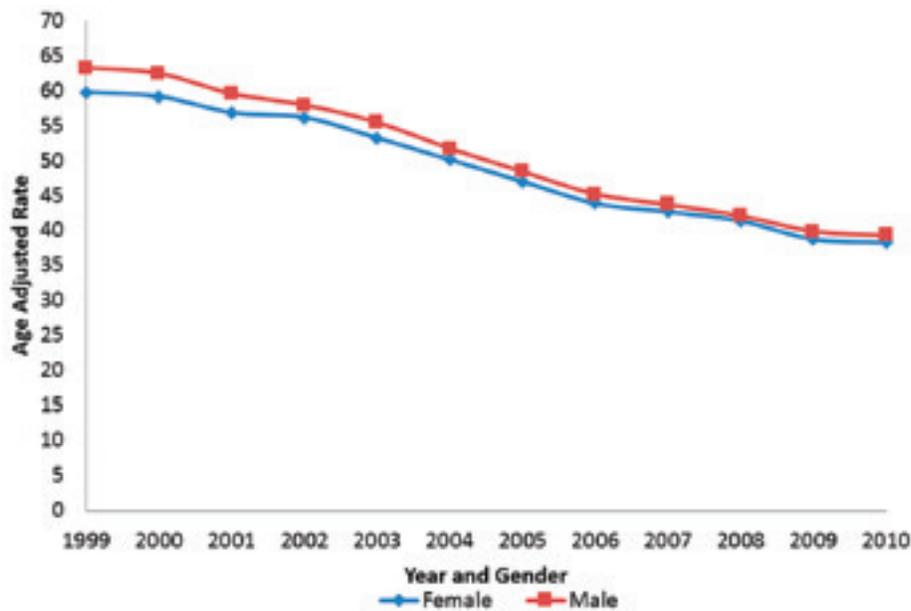


Figure 8. Age-adjusted death rates for stroke by gender, 1999-2010³⁵

Rates are per 100,000 persons and are standardized to the 2000 U.S. population. Diseases are classified according to ICD-10 (codes 160-169).

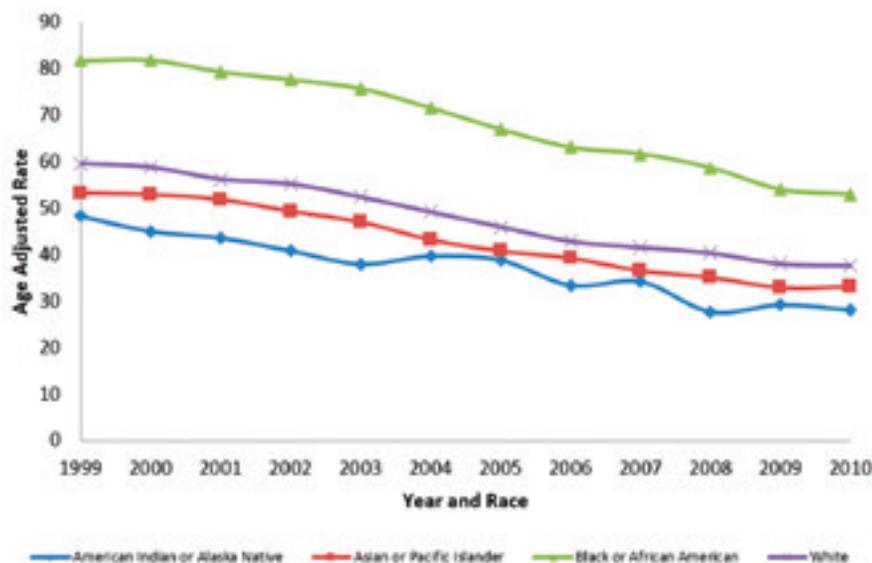


Figure 9. Age-adjusted death rate for stroke by race/ethnicity, 1999-2010³⁵

Rates are per 100,000 persons and are standardized to the 2000 U.S. population. Diseases are classified according to ICD-10 (codes 160-169).

There were almost 1 million hospitalizations for stroke in 2009, out of which 52% were among females and 66% were 65 years or over. The average length of stay for stroke patients was 10.2 days in 1989, 5.4 days in 1999, and 5.3 days in 2009.⁴⁰ The rate of hospitalization for stroke increased from 32.4 to 34.9 per 10,000 population from 1989 to 1999, but by 2009 the rate had decreased to 31.8 per 10,000 (Figure 10). Stroke hospitalizations with a comorbidity of hypertension increased from 37% in 1989 to 58% in 2009.

Figure 10 shows the hospitalization rate for stroke by age with stroke as the principal or first-listed diagnosis. The definition includes hospitalizations for acute stroke, transient ischemic attack, and for late effects of stroke. That is, stroke is the main cause or reason for the hospitalization and is recorded using International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) codes 430-438.⁴⁰

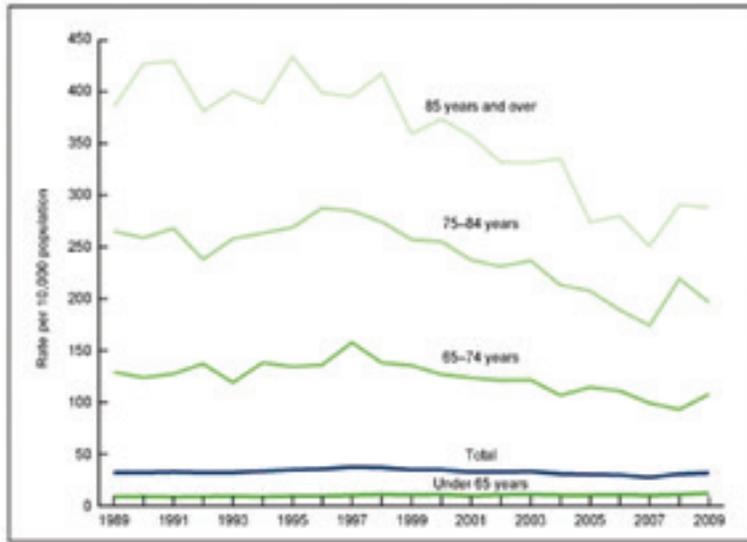


Figure 10. Hospitalization rate for stroke, by age: United States, 1989–2009⁴⁰

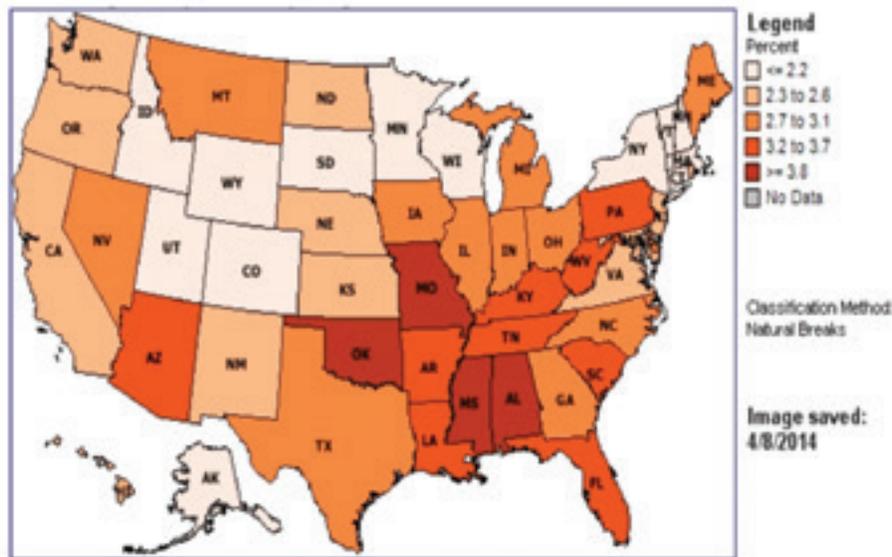


Figure 11. Self-reported prevalence of stroke among 18 years of age and older 2010³⁷

Figure 11 shows the percentage of BRFSS respondents answering yes to the question were you “ever told you had a stroke?” during the 2010 survey. In 2010, 2.7% respondents to the Behavioral Risk Factor Surveillance System who were 18 years of age and older reported ever having had a stroke.³⁷ The National Health Interview Survey, 2011–2012, reported average annual percentage of stroke among adults aged 18 and over, which showed that stroke prevalence

- Increased with age for both males and females.
- Were higher in African-Americans.⁴¹
- Were lower non-Hispanics.⁴¹
- Higher in southern region of the United States.⁴¹



DISPARITIES IN HEART ATTACKS AND STROKES

Results from the National Health Interview Survey for 2008⁴² indicate that

- Of all the single-race sex ethnicity groups, non-Hispanic white men had the highest percentage of heart disease.
- Black adults are more likely to have been diagnosed with hypertension (high blood pressure)—the single most important modifiable risk factor for ischemic stroke—than are Asian adults or white adults.
- The lower the educational level, the higher the percentages of adults with heart disease, hypertension, or stroke.
- Adults in families that are poor or near poor are more likely to have been diagnosed with heart disease, hypertension, or stroke than are adults in families that are not poor.

WHAT YOU CAN DO

You can adopt several strategies to lessen your risk of heart disease and stroke.

- Manage blood pressure, cholesterol, and diabetes through a healthy diet and exercise routine, and take medications as prescribed.
- Eat a healthy diet that includes fresh fruits and vegetables. Lower or cut out added salt or sodium, and eat less saturated fat and cholesterol.
- Engage in moderate-level aerobic activities for at least 150 minutes every week plus muscle-strengthening activities on 2 or more days a week.
- Do not smoke or spend significant time in places where others regularly smoke.

- Avoid breathing air laden with particulate matter (dust, smoke, exhausts, pollen, etc.) at home and at your workplace.
- Wear respiratory masks during days of high pollution or while performing tasks that fill the air with dust, smoke, or pollen, such as sweeping, gardening, raking, and mowing.
- Stay cool on hot days and warm on cold days and avoid overexertion on days of temperature extremes.
- Dress warmly when out in extremely cold weather. Cover your head and hands, and cover your mouth and nose with a muffler to protect your lungs from ice-cold air.

ADDITIONAL RESOURCES

Many resources offer information on heart disease and stroke and are readily available on the internet. Following are several sites that may be helpful to you:

- CDC Division for Heart Disease and Stroke Prevention at www.cdc.gov/dhdsp/
- American Heart Association at www.heart.org/
- The WISEWOMAN program (Well-Integrated Screening and Evaluation for Women Across the Nation) helps women without adequate health insurance gain access to screening and lifestyle interventions that can reduce their risk for heart disease, stroke, and other chronic diseases at www.cdc.gov/wisewoman/

REFERENCES

1. Deaths: Final data for 2010. National Vital Statistics Reports; vol 61 no 4. Hyattsville, MD: National Center for Health Statistics. 2013. [cited 2014 April 30];61(4) Available from URL: http://www.cdc.gov/nchs/data/nvsr/nvsr61/nvsr61_04.pdf.
2. CDC, Prevalence of Stroke - United States, 2006–2010 MMWR. May 25, 2012 / 61(20);379–382 Available from URL: http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6120a5.htm?s_cid=mm6120a5_w
3. Go AS, Mozaffarian D, Roger VL, Benjamin EJ, et al., on behalf of the American Heart Association (AHA). Heart disease and stroke statistics—2014 update: A report from the American Heart Association. *Circulation* [online] 2014 [cited 2014 May 1];129:e28–e292. Available from URL: <http://circ.ahajournals.org/content/129/3/e28>.
4. Stone PH, Godleski JJ. First steps toward understanding the pathophysiologic link between air pollution and cardiac mortality. *Am Heart J* 1999;138(5):804–7.
5. Brook RD, Franklin B, Cascio W, Hong YL, Howard G, Lipsett M, et al. Air pollution and cardiovascular disease—a statement for healthcare professionals from the expert panel on population and prevention science of the American Heart Association. *Circulation* 2004; 109(21):2655–71.
6. AHA. Heart and stroke facts [online]. 2014. [cited 2014 May 1]. Available at URL: http://www.heart.org/HEARTORG/Conditions/Conditions_UCM_001087_SubHomePage.jsp.
7. Pearson TA, Blair SN, Daniels SR, Eckel RH, Fair JM, Fortmann SP, et al. AHA guidelines for primary prevention of cardiovascular disease and stroke: 2002 update: Consensus panel guide to comprehensive risk reduction for adult patients without coronary or other atherosclerotic vascular diseases. *Circulation* 2002;106(3):388–91.
8. Donaldson, K, Stone V, Seaton A, MacNee W. Ambient particle inhalation and the cardiovascular system: Potential mechanisms. *Environ Health Perspect* 2001; 109(S4):523–27.
9. Pope, CA III, Burnett RT, Thurston GD, Thun MJ, Calle EE, Krewski D, et al. Cardiovascular mortality and long-term exposure to particulate air pollution—epidemiological evidence of general pathophysiological pathways of disease. *Circulation* 2004;109(1):71–77.
10. Samet, JM, Dominici F, Currier FC, Coursac I, Zeger SL. Fine particulate air pollution and mortality in 20 U.S. cities, 1987–1994. *N Engl J Med* 2000;343(24):1742–49.
11. Hoek G, Brunekreef B, Goldbohm S, Fischer P, van den Brandt PA. Association between mortality and indicators of traffic-related air pollution in the Netherlands: a cohort study. *Lancet* 2002;360(9341):1203–09.
12. Peters A, von Klot S, Heier M, Trentinaglia I, Hormann A, Wichmann HE, et al. Exposure to traffic and the onset of myocardial infarction. *N Engl J Med* 2004;351(17):1721–30.
13. Dockery DW, Pope CA, Xu X, Spengler JD, Ware JH, Fay ME, et al. An association between air pollution and mortality in six United States cities. *N Engl J Med* 1993;329(24):1753–59.
14. Pope, CA III, Burnett RT, Thun MJ, Calle EE, Krewski D, Ito K, et al. Lung cancer, cardiopulmonary mortality, and long-term exposure to fine particulate air pollution. *JAMA* 2002;287(9):1132–1141.
15. Laden F, Schwartz J, Speizer FE, Dockery DW. Reduction in fine particulate air pollution and mortality—extended follow-up of the Harvard six cities study. *Am J Respir Crit Care Med* 2006;173(6):667–72.
16. Miller KA, Siscovick DS, Sheppard L, Shepherd K, Sullivan JH, Anderson GL, et al. Long term exposure to air pollution and incidence of cardiovascular events in women. *N Engl J Med* 2007;356(5):447–58.
17. U.S. Department of Health and Human Services (HHS), Office of the Surgeon General. The health consequences of involuntary exposure to tobacco smoke: a report of the Surgeon General [online]. 2006. [cited 2010 Aug 30]. Available from URL: <http://www.surgeongeneral.gov/library/secondhandsmoke/report>.
18. Ellis FP. Mortality from heat illness and heat-aggravated illness in the United States. *Environ Res* 1972;5(1):1–58.
19. Schuman SH. Patterns of urban heat-wave deaths and implications for prevention: data from New York and St. Louis during July 1966. *Environ Res* 1972;5(1):59–75.
20. Gover M. Mortality during periods of excessive temperature. *Public Health Rep* 1938;53: 1122–43.
21. Schuman SH, Anderson CP, Oliver JT. Epidemiology of successive heat waves in Michigan in 1962 and 1963. *JAMA* 1964;189(10): 733–8.
22. Bridger CA, Helfand LA. Mortality from heat during July 1966 in Illinois. *Int J Biometeorol* 1968;12(1):51–70.
23. Henschel A, Burton LL, Margolies L, Smith JE. An analysis of the heat deaths in St. Louis during July 1966. *Am J Public Health* 1969;59(12):2232–42.
24. Ellis FP, Prince HP, Lovatt G, Whittington RM. Mortality and morbidity in Birmingham during the 1976 heatwave. *Q J Med* 1980;49(1): 1–8.
25. Applegate WB, Runyan JW Jr, Brasfield L, Williams ML, Konigsberg C, Fouche C. Analysis of the 1980 heat wave in Memphis. *J Am Geriatr Soc* 1981;29:337–42.
26. Semenza JC, Rubin CH, Falter KH, Selanikio JD, Flanders WD, Howe HL, et al. Heat-related deaths during the July 1995 heat wave in Chicago. *N Engl J Med* 1996;335(2):84–90.
27. European Commission, Public Health. Cold can kill—excess winter deaths [online]. undated. [cited 2010 Aug 30]. Available from URL: http://ec.europa.eu/health/ph_information/dissemination/unexpected/unexpected_8_en.htm.
28. Passchier-Vermeer W, Passchier WF. Noise exposure and public health. *Environ Health Perspect* 2000;108(S1):123–131.
29. Babisch, W. Noise and health. *Environ Health Perspect* 2005;113(1):A14–A15.

30. Centers for Disease Control and Prevention. Environmental Public Health Tracking Network. Hospitalizations for Heart Attack. Accessed From: www.cdc.gov/ephtracking. Accessed on [April 30, 2014] National Center for Health Statistics. Health, United States, 2012 With Special Feature on Emergency Care. Hyattsville, Maryland: 2013. Summary health statistics for U.S. adults: National Health Interview Survey, 2012. Available from URL: <http://www.cdc.gov/nchs/data/hus/hus12.pdf>.
31. O'Neill MS, Jerrett M, Kawachi I, Levy JI, Cohen AJ, Gouveia N, et al. Health, wealth and air pollution: advancing theory and methods. *Environ Health Perspect* 2003;111(16):1861–70.
32. Sexton K, Gong H Jr, Bailar JC III, Gold DR, Lambert WE, Utell MJ. Air pollution health risks: do class and race matter? *Toxicol Ind Health* 1993;9(5):843–78.
33. Zhu Y, Hinds WC, Kim S, Siouta SC. Concentration and size distribution of ultrafine particles near a major highway. *J Air Waste Manage Assoc* 2002;52(9).
34. CDC, NCHS. Wide-ranging Online Data for Epidemiologic Research (WONDER), compiled from compressed mortality file, 1999–2010, [online]. [cited 2014 May 1].
35. Available from URL: <http://wonder.cdc.gov/mortSQL.html>.
36. CDC. Division for Heart Disease and Stroke Prevention: Data Trends and Maps [online]. 2014. [cited 2014 May 30] Available from URL: http://nccd.cdc.gov/DHDSP_DTM/DetailedData.aspx?state=United States&category=7&indicator=43&stratification=Gender
37. CDC. BRFSS, United States, 2012 [online]. 2011. [cited 2013 Nov 21]. Available from URL: <http://apps.nccd.cdc.gov/gisbrfss/default.aspx>
38. Go AS, Mozaffarian D, Roger VL, Benjamin EJ, Berry JD et al. Heart disease and stroke statistics 2013 update: a report from the American Heart Association. *Circulation* [online] 2013 [Cited 2013 Nov 21] 127(1): e6–e245. Available at URL: <http://circ.ahajournals.org/content/127/1/e6.full>
39. Casper ML, Barnett E, Williams GI Jr, Halverson JA, Braham VE, Greenlund KJ. Atlas of stroke mortality: racial, ethnic, and geographic disparities in the United States. Atlanta (GA): HHS, CDC; 2003.
40. Hall MJ, Levant S, DeFrances CJ. Hospitalization for stroke in U.S. hospitals, 1989–2009. NCHS data brief, no 95. Hyattsville, MD: National Center for Health Statistics. 2012.
41. CDC/National Center for Health Statistics/Office of Analysis and Epidemiology. 2014. Health, United States, 2012: Web Updates. Table 44. Respondent-reported prevalence of heart disease, cancer, and stroke among adults aged 18 and over. [online] Available at URL: Updated Stroke Webpage NHIS data: <http://www.cdc.gov/nchs/hus/contents2012.htm#044>.
42. Adams PF, Kirzinger WK, Martinez ME. Summary health statistics for the U.S. population: National Health Interview Survey, 2011. National Center for Health Statistics. *Vital Health Stat* 10(255). 2012.